Invited Commentary

Diagnosis of Cervical Disorders: Exploring a Mechanistic Approach

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Abstract: A current direction in research into cervical disorders is towards investigating the value of a "mechanisms" approach to diagnosis. This commentary reviews some of the research investigating the pathophysiological features of neck pain, in terms of changes in the articular, muscle, sensorimotor and sensory systems. Changes have been found in patterns of cervical muscle activation in cognitive, functional and automatic tasks in neck pain patients. In addition, some patients have been found to have disturbances in features of the postural control system in association with their neck disorders. Altered responses to sensory testing have also been determined, particularly in some patients with whiplash-induced neck pain. The value of this mechanisms approach to diagnosis is in its ability to direct specific treatment strategies to address the precise impairments presenting in the individual neck pain patient. It supports the evidence that indicates that a multimodal approach to management is likely to be most efficacious.

Key words: cervical spine, diagnosis, classification, impairment

Introduction

Neck pain is a relatively common complaint, especially in this age of information technology with the inherent prolonged sedentary postures at work and at home. It has a point prevalence of between 10% and 20% [1–3], and 40–50% of the population will suffer neck pain in any 1 year [1,4]. In the USA, neck pain is second only to lower back pain in annual workers' compensation costs [5]. These statistics alone show the need for effective management and prevention programmes. This is reinforced by the notable statistic that neck pain tends to be a persistent and recurrent disorder, and up to 60% of persons can expect some degree of ongoing pain for many years following their first episode of neck pain [6]. Recurrent neck pain leads to significant costs not only economically but also in terms of quality of life.

The literature reveals that many and diverse treatments have been tested or offered for neck pain. Such diversity in itself raises many questions. A principal one is what have been the diagnostic indicators to direct the various treatments? In the Western medical model, diagnosis has traditionally been driven by the desire to obtain a pathoanatomical diagnosis. This approach has failed for neck pain, as for most patients, definitive pathology cannot be identified. Patients often receive a diagnosis of non-specific neck pain, which does not provide strong directives for treatment. Recent clinical guidelines for the management of acute neck pain have recommended (in the absence of identifiable, relevant pathology and other features suggestive of red-flag conditions) that neck pain be classified merely as either idiopathic or whiplash-induced [7]. However, as with the pathoanatomical model, this classification does not recognize neck pain as a potentially complex biological and psychological event and also fails to direct management. There is a need for different directions for diagnosis and classification, and this change is beginning to

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happen internationally, with an increasing amount of research being directed towards understanding the pathophysiology of neck pain. Thus, the direction is towards developing a "mechanisms"-based diagnosis that has the potential to direct specific interventions. This fits well with the clinical reasoning model used by physiotherapists in their physical examination of the neck pain patient.

This commentary will review some of the research principally undertaken in the Physiotherapy Division at The University of Queensland, Australia, to investigate whether this "mechanisms" approach is likely to be helpful towards driving a change in the diagnostic model for neck pain and, importantly, whether it can better direct physical therapy interventions. A sample of impairments found in the musculoskeletal, sensorimotor and sensory systems will be considered.

Movement and Symptomatic Joint Dysfunction

Assessment of movement and manual examination of the cervical region are fairly routine assessments conducted by physiotherapists. Range of cervical movement is a generic measure of neck impairment and lacks specificity to an explicit disorder or stage of a disorder. However, from a diagnostic sense, it has value as a measure to characterize patients with neck disorders. For example, range of movement can discriminate patients with chronic whiplash-associated disorders from control subjects with high sensitivity and specificity [8]. Likewise, a reduced range of movement distinguishes cervicogenic headache sufferers from those with migraine and tension-type headache [9,10]. Manual examination of the cervical segments is also a non-specific test from a pathological point of view. This method tests the responsiveness of a cervical segment to manually induced motion in qualitative terms of the nature of tissue resistance and pain provocation. This method of examination has not fared well from the perspective of inter-therapist reliability to grade hypo- or hypermobility. Nevertheless, when manual examination has been tested to answer a more general question, namely, is painful cervical segmental dysfunction present in a particular subject or subject group, its value is proven from a diagnostic perspective. Discreet provocation of pain over a cervical zygapophysial joint identifies neck pain subjects from asymptomatic control subjects and, in the case of headache, manual examination has very acceptable sensitivity and specificity to detect those with cervicogenic headache from those with non-cervicogenic headaches [11–16]. Thus, the assessment of regional movement and the assessment of the presence of painful cervical segmental dysfunction are proving their value in detecting impairment in the cervical region.

From a clinical management perspective, a reduced range of movement would direct inclusion of mobilizing exercises in a management programme, and physiotherapists have several approaches to address symptomatic segmental joint dysfunction, including manual therapy and specific exercises, the efficacy of which has been proven in the management of neck pain [17–20]. Likewise, possible mechanisms of the effect of manual therapy are beginning to be better understood [21,22]. However, it must be noted that the evidence suggests that manual therapy alone is insufficient for the management of neck disorders [23]. This should not be unexpected as the evidence suggests that relief of pain does not automatically guarantee a return of muscle function [18,24].

Cervical Muscle Function

Impairment in muscle function is a hallmark of musculoskeletal disorders, and general strength training is often incorporated into rehabilitation programmes. In line with this approach, changes have been identified in cervical muscle strength, fatigability and neuromuscular efficiency in patients with neck pain [25–27]. In recent years, physiotherapists have had an increasing interest in problems of motor control in association with musculoskeletal pain states in all regions of the body, and it is possible that addressing muscle strength alone may be an oversimplified approach to the rehabilitation of muscle function.

In respect of issues of motor control in the cervical region, our research has focused principally on the neck flexor synergy, and detailed work with the neck extensor muscles is yet to be completed. Deficits in the motor control of the deep and superficial cervical flexor muscles have been identified in patients with chronic neck pain. These motor control deficits have been characterized by a delay in onset of neck flexor activity, most significantly in the deep neck flexors, associated with movement of the upper limb [28]. This delay in onset of contraction of the neck flexor muscles indicates a deficit in the automatic motor command for feed-forward control in patients with neck pain. It can be suggested that such a change in the feed-forward response may leave the cervical spine vulnerable to strain from the reactive forces resulting from the movement. Altered patterns of cervical flexor muscle activation have also been demonstrated in both low-load cognitive and functional tasks in neck pain patients compared with control subjects. In the cognitive task of craniocervical flexion, reduced deep cervical flexor muscle activity has been demonstrated in those with neck pain, and this has been accompanied by increased activity in the superficial flexors, the sternocleidomastoid and anterior scalene muscles [29–31]. This pattern suggests possible compen-

sation by the superficial muscles in the presence of impaired deep cervical flexors in neck pain patients. This altered pattern of muscle activity in the craniocervical flexion test also appears to translate to functional activities, where increased activity of the superficial cervical flexor muscles has been measured in neck pain patients during a simple pencil tapping task [32]. Alterations in the pattern of axioscapular muscle activation were also evident during the performance of this functional task. Neck pain subjects had reduced activity in the trapezius on their dominant side. This may represent an altered strategy to minimize activation of painful muscles. There was increased activity on the non-dominant side, which rested on the table during the task, and this may be compensation for inhibited, deeper muscles. This pattern in the trapezius muscles was also noted by Nederhand et al with the same task [33].

The changes in patterns of muscle activity in the neck and shoulder girdle found to date, as well as the delays in onset of neck flexor activity associated with movement of the upper limb, suggest that therapeutic exercise should first be directed towards motor relearning [34]. This programme would include a focus on activating the deep neck and girdle muscles with low-load and precise exercises in the first instance. Precision is a key and these exercises need to be performed repeatedly in the motor learning process. The muscles' tonic endurance capacity should be trained with low-load holding actions in line with their functional supporting role. Re-education of posture in a neutral upright lumbopelvic position with restoration of the normal lumbar, thoracic and cervical curves and shoulder girdle position is an important component of the relearning process for these muscles. Again, re-education needs to be precise to facilitate the appropriate patterns of muscle activity in their functional, postural supporting roles. Also, appropriate training of the activation of the muscles in movement patterns of the neck and girdle is frequently required using both specific exercises as well as patient-specific functional tasks. Once the synergistic interaction of the deep and superficial muscles is achieved, co-contraction exercises can be introduced to further enhance muscular stability of the cervicobrachial region. The muscle system can then be loaded to restore strength and endurance to the functional demands of the patient.

Impairments in the Sensorimotor System

While our research has had a particular focus on the neck flexors, further research is needed to understand the function or dysfunction in the extensor muscles with neck disorders. Some research is forthcoming which is of clinical interest. For example, McPartland et al report a pilot study in which marked atrophy and fatty infiltration was found in the rectus capitis posterior minor and major muscles in a small group of patients with chronic neck pain [35]. The atrophy and fatty infiltration were related to a decrease in standing balance in these patients compared with control subjects, which the authors suggest could reflect reduced proprioceptive output from these muscles. Indeed, there is a growing body of evidence to indicate the presence of disturbances in the postural control system in neck pain patients.

Disturbances in cervical kinesthetic sense (joint position error) have been measured in patients with idiopathic and whiplash-induced neck pain [36,37]. Furthermore, in the case of chronic whiplash-associated disorders, greater joint position errors have been measured in those complaining of dizziness and unsteadiness in association with their neck pain [37]. Even though the causes of these symptoms might be multiple, including involvement of the vestibular system, anxiety or medication side effects, the evidence suggests that disturbed cervical afferentation probably plays a substantive role. Such patients also display disturbances in balance responses [38] and eye movement control [39].

The ideal treatment for these disorders has not been researched fully to date, although studies have shown improvement in pain and/or dizziness with an eye–head coupling rehabilitation programme [40], a gaze-stability and head movement programme [41], and with manual therapy and multimodal physiotherapy programmes [42, 43]. It is notable that the presence of dizziness/lightheadedness in association with cervicogenic headache predicts a poorer outcome after physiotherapy management [44]. In this trial, no exercises were directed specifically towards re-education of the potentially disordered cervical afferent input into the postural control system, which may have been underlying these symptoms. This points to the need for possible deeper consideration of therapeutics to address disordered postural control in neck pain patients presenting with these symptoms.

Impairments in the Sensory System

There has been growing interest in investigating the possible underlying mechanisms of pain in patients with neck pain, which can influence the management approach. In our research into whiplash-induced neck pain, widespread mechanical hyperalgesia has been found in those with problematic chronic whiplash-associated disorders [45]. Notably, in a comparative study testing both temperature and pressure pain thresholds in those with chronic neck pain of idiopathic and whiplash-induced origins, widespread sensory disturbances were not a feature of those with idiopathic neck pain. However, they featured in many of the chronic whiplash subjects [46]. These changes suggest the presence of abnormal pain processing in the central nervous system in these

patients. From a physiotherapy management perspective, this indicates that it is important that the treatment approach be non-pain provocative for these patients, as pain-provoking techniques are likely to compound the problem and exacerbate the patient's symptoms.

Perhaps most important in relation to sensory disturbances is the study by Sterling et al [47], which shows that these disturbances occur early after the whiplash injury (measured within 1 month of injury), particularly in patients who report higher levels of pain and disability. The disturbances did not resolve with time (measured at 6 months post-injury) and these patients continued to suffer quite high levels of pain and disability. Furthermore, in an exploratory clinical trial investigating the effectiveness of physiotherapy management for chronic whiplash-associated disorders (Jull et al, unpublished data), whiplash patients with widespread mechanical and cold hyperalgesia responded least to physiotherapy management. As these changes occur early after injury, it suggests that physiotherapy alone is unlikely to be helpful for these patients. Rather, an early multiprofession approach is indicated, and in particular, these patients require appropriate medical pain management.

Conclusion

The pathoanatomical approach to diagnosis has proven inadequate for the vast majority of neck pain patients, especially in relation to directing conservative management. A mechanisms approach to diagnosis is showing great promise, especially when considering the implications for management derived from the detailed examination of the muscle, sensorimotor and sensory systems of the cervical region. Further work continues to define these impairments. However, treatments can be more rationally applied even with the current base of knowledge. A demand can now be made that future clinical trials rationalize their management approach, rather than perpetuate studies that appear to test treatments on a more haphazard basis.

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